

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION
JUNE 2012 SESSION

JJ517: INSTRUMENTATION & CONTROL

DATE: 21 November 2012 (Wednesday)
DURATION: 2 HOURS (8.30 AM - 10.30 AM)

This paper consists of **SIX (6)** pages including the front page.

Essay (6 questions – answer 4 questions)

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THE CHIEF INVIGILATOR

(The CLO stated is for reference only)

ESSAY (100 marks)

INSTRUCTION:

This section consists of **SIX (6)** questions. Answer **FOUR (4)** questions.

QUESTION 1

- a) i. Give **THREE (3)** categories of transducer. [CLO1, C1]
(3 marks)
- ii. Explain **THREE (3)** categories of transducer stated in (i) with examples. [CLO1, C2]
(9 marks)
- b) Draw the block diagram for basic measurement system. [CLO1, C1]
(4 marks)
- c) A temperature sensor has a span of $20^{\circ} - 250^{\circ}\text{C}$. The reading of the temperature detected by the sensor is 55°C . Specify the error if the accuracy is
- i) $\pm 0.5\%$ of full scale
ii) $\pm 0.75\%$ of span
iii) $\pm 0.8\%$ of reading.
iv) What is the range of the possible temperature in each case?
[CLO 1: C2]
(9 marks)

QUESTION 2

- a) Name TWO (2) types of measurement for industrial application. [CLO 1 : C1]
(2 marks)
- b) The pressure measurement can be performed by using the bourdon gauge.
 - i) Sketch the bourdon gauge and label all of the components. [CLO 1: C1]
(5 marks)
 - ii) By referring to the question b(i), describe the operation of bourdon gauge for pressure measurement. [CLO 1 : C2]
(6 marks)
- c) State TWO (2) mechanical indirect methods of the liquid level measurement. [CLO 1 : C1]
(2 marks)
- d) Identify TWO (2) advantages and ONE (1) disadvantage of Electromagnet Flow Meter usage. [CLO 1 : C1]
(6 marks)
- e) Explain Metal Intermediate Law and Temperature Intermediate Law. [CLO1:C2]
(4 marks)

QUESTION 3

- a) Describe briefly the control system with the help of the simple diagram. [CLO2: C1]
(6 marks)
- b) Briefly describe the relationship between block diagram and the transfer function. [CLO 1: C3]
(7 marks)
- c) Simplify the block diagram in Figure 3C through reduction method. [CLO2:C4]
(12 marks)

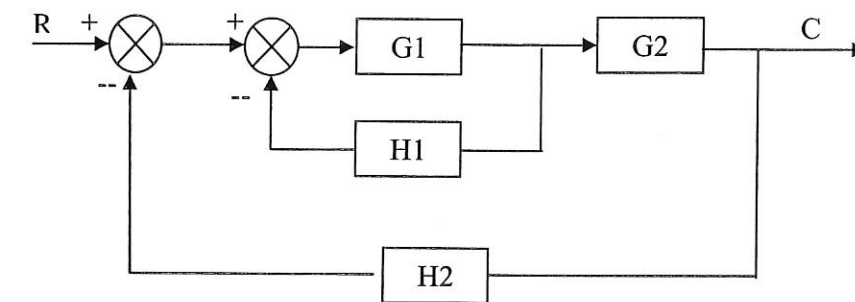


Figure 3C

QUESTION 4

a) Define the following terms in control system: [CLO 1:C1]

- Feedback Control System
- Servo Control System
- Process Control System

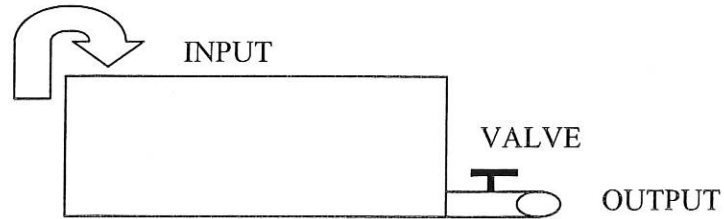
(9 marks)

b) State TWO (2) advantages and TWO (2) disadvantages of the open loop system. [CLO 1:C2]

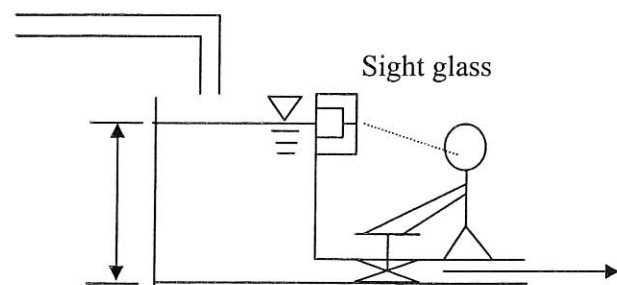
(4 marks)

c) Draw the block diagram according to the given diagram below.

i) Release valve is opened to control the outflow. The valve can be considered as a controller and flow as a process.



ii) Liquid level control performed by an operator who operates the control valve. When the water level reaches the upper limit, the operator opens the valve and then when the liquid level is at the lower limit, the valve will be closed.



[CLO2, C4]
(12 marks)

QUESTION 5

a) Describe briefly the conditions which you would select a Proportional, Integral and Derivative control mode. [CLO 1: C3]

(12 marks)

b)

The process control system has a control valve and a small capacitance. Sudden, moderate load changes are expected and a small offset error can be tolerated.

Based on statement above, recommend the control mode or combination of modes most suitable for controlling this system. [CLO 2: C4]

(13 marks)

QUESTION 6

a) Define the terms below:

- i) Interface
- ii) Analog Input & Output
- iii) Digital Input & Output
- iv) Analog Digital Converter (ADC)
- v) Digital Analog Converter (DAC)
- vi) Multiplex
- vii) Demultiplex

[CLO2, C1]
(7 marks)

b) Explain **TELEMETRY** with related diagram. [CLO2, C2]

(6 marks)

c) Explain the characteristics of the following; [CLO2, C4]

- i. Supervisory Control
- ii. Direct Digital Control

(12 marks)